RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF INTERLEAVED MULTIPLE REPRODUCTION PATH VIDEO DATA RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES

BACKGROUND OF THE INVENTION

Field of the Invention

[0001]   The present invention relates to a recording medium having a data structure for managing reproduction of at least multiple reproduction path video data recorded thereon as well as methods and apparatuses for reproduction and recording.

Description of the Related Art

5   [0002]   The standardization of new high-density read only and rewritable optical disks capable of recording large amounts of high-quality video and audio data has been progressing rapidly and new optical disk related products are expected to be commercially available on the market in the near future. The Blu-ray Disc Rewritable (BD-RE) is one example of these 10 new optical disks.

[0003]   Fig. 1 illustrates the file structure of the BD-RE. The file structure or data structure provides for managing the reproduction of the video and audio data recorded on the BD-RE. As shown, the data structure includes a root directory that contains at least one BDAV directory. The 15 BDAV directory includes files such as 'info.bdav', 'menu.tidx', and 'mark.tidx',

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a PLAYLIST subdirectory in which playlist files (*.rpls and *.vpls) are stored, a CLIPINF subdirectory in which clip information files (*.clpi) are stored, and a STREAM subdirectory in which MPEG2-formatted A/V stream clip files (*.m2ts) corresponding to the clip information files are stored. In addition to

5 illustrating the data structure of the optical disk, Fig. 1 represents the areas of the optical disk. For example, the general information file info.bdav is stored in a general information area or areas on the optical disk.

[0004] Because the BD-RE data structure and disk format as illustrated in Fig. 1 is well-known and readily available, only a brief overview

10 of the file structure will be provided in this disclosure.

[0005] As alluded to above, the STREAM directory includes MPEG2-formatted A/V stream files called clips or clip files. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A bridge-clip is used for making seamless connection between two

15 or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an

20 address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

[0006]   The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information.   The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

[0007]   The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number). The presentation time stamp (PTS) and the source packet number (SPN) are related to an entry point in the AV stream; namely, the PTS and its related SPN point to an entry point on the AV stream. The packet pointed to is often referred to as the entry point packet.

[0008]   The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of

editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point

5 that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

10   **[0009]**   A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and

15 therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

     [0010]   The info.bdav file is a general information file that provides general information for managing the reproduction of the A/V stream recorded on the optical disk. More specifically, the info.bdav file includes,

20 among other things, a table of playlists that identifies the file names of the playlist in the PLAYLIST directory of the same BDAV directory.

     [0011]   The menu.tidx, menu.tdt1 and menu.tdt2 files store information related to menu thumbnails. The mark.tidx, mark.tdt1 and

mark.tdt2 files store information that relates to mark thumbnails. Because these files are not particularly relevant to the present invention, they will not be discussed further.

[0012] The standardization for high-density read-only optical disks such as the Blu-ray ROM (BD-ROM) is still under way. An effective data structure for managing reproduction of video and audio data recorded on the high-density read-only optical disk such as a BD-ROM is not yet available.

SUMMARY OF THE INVENTION

[0013] The recording medium according to the present invention includes path management information for managing the reproduction of at least multiple reproduction path video data (e.g., different camera angles of video data).

[0014] In one exemplary embodiment, the recording medium includes a data area storing at least a portion of the multiple reproduction path video data. The multiple reproduction path video data is divided into one or more interleaving units, and each interleaving unit is associated with one of the reproduction paths. Each interleaving unit starts and ends with a reproduction path change point, and the interleaving units associated with different reproduction paths are interleaved in the data area.

[0015] In an exemplary embodiment, the multiple reproduction path video data is divided into a plurality of clip files, and each clip file includes video data associated with one of the multiple reproduction paths.

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Here, each clip file is divided into one or more of the interleaving units. The video data in each interleaving unit may also be divided into one or more entry points.

The recording medium according to another exemplary embodiment of 5 the present invention, associated with any of the above described embodiment, further includes a management area storing management information. The management information includes at least one entry point map associated with each reproduction path, and each entry point map identifies entry points in the video data for the associated reproduction path. In this embodiment, 10 each entry point map may indicate which of the identified entry points is a last entry point in an interleaved unit. Alternatively, each entry point map may indicates which of the identified entry points is a first entry point in an interleaved unit.

[0016]   In another exemplary embodiment of the present 15 invention, the recording medium includes a data area storing a plurality of clip files. Each clip file includes video data associated with one of the multiple reproduction paths, and is divided into entry points of video data. The entry points in each clip file are grouped into one or more interleaving units, and the plurality of clip files are interleaved in the data area on a interleaving unit 20 basis. In this and the other embodiments of the present invention, each interleaved unit may include the same number of entry points, or alternatively, at least two interleaved units may have a different number of entry points.

[0017]   The present invention further provides apparatuses and

methods for recording and reproducing the data structure according to the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]   The above features and other advantages of the present invention will be more clearly understood from the following detailed

5   description taken in conjunction with the accompanying drawings, in which:

[0019]   Fig. 1 illustrates the prior art file or data structure of a rewritable optical disk according to the Blu-ray Disc Rewritable (BD-RE) standard;

[0020]   Figs. 2 illustrates an exemplary embodiment of a

10   recording medium file or data structure according to the present invention;

[0021]   Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon;

[0022]   Fig. 4 illustrates an embodiment of the data structure for managing the multiple reproduction path data streams;

15   [0023]   Figs. 5 and 6 each illustrates an embodiment of the interleaving unit IU data structure according to the present invention;

[0024]   Fig. 7 illustrates the time alignment that may exist between the entry point maps for the different clip files in the embodiments of the present invention; and

20   [0025]   Fig. 8 illustrates a schematic diagram of an embodiment of an optical disk recording and reproduction apparatus of the present

invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026]   In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

5   [0027]   A high-density optical disk, for example, a Blu-Ray ROM (BD-ROM), BD-RE, etc. in accordance with the invention may have a file or data structure for managing reproduction of video and audio data as shown in Fig. 2. Many aspects of the data structure according to the present invention shown in Fig. 2 are similar to that of the BD-RE standard discussed with 10 respect to Fig 1. As such these aspects will not be described in great detail.

[0028]   As shown in Fig. 2, the root directory contains at least one DVP directory. The DVP directory includes a general information file info.dvp, menu files menu.tidx, menu.tdt1 among others, a PLAYLIST directory in which playlist files (e.g., real (*.rpls) and virtual (*.vpls)) are stored, 15 a CLIPINF directory in which clip information files (*.clpi) are stored, and a STREAM directory in which MPEG2-formatted A/V stream clip files (*.m2ts), corresponding to the clip information files, are stored.

[0029]   The STREAM directory includes MPEG2-formatted A/V stream files called clips or clip files. The A/V stream includes source packets 20 of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet

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number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have

5   the same PID.

[0030]   The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information.   The sequence

10 information describes the arrival time basis (ATC) and system time basis (STC) sequences.   For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source

15 packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

[0031]   The timing information is referred to as characteristic

20 point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number). The presentation time stamp (PTS) and the source packet

number (SPN) are related to an entry point in the AV stream; namely, the PTS and its related SPN point to an entry point on the AV stream. The packet pointed to is often referred to as the entry point packet.

[0032] The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

[0033] A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

[0034] The info.dvp file is a general information file that provides general information for managing the reproduction of the A/V streams

recorded on the optical disk. More specifically, the info.dvp file includes, among other things, a table of playlists that identifies the file names of the playlists in the PLAYLIST directory. The info.dvp file will be discussed in greater detail below with respect to the embodiments of the present invention.

5   **[0035]**   In addition to illustrating the data structure of the recording medium according to an embodiment of the present invention, Fig. 2 represents the areas of the recording medium. For example, the general information file is recorded in one or more general information areas, the playlist directory is recorded in one or more playlist directory areas, each

10   playlist in a playlist directory is recorded in one or more playlist areas of the recording medium, etc. Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon. As shown, the recording medium includes a file system information area, a data base area and an A/V stream area. The data base area includes a general information file and

15   playlist information area and a clip information area. The general information file and playlist information area have the general information file recorded in a general information file area thereof, and the PLAYLIST directory and playlist files recorded in a playlist information area thereof. The clip information area has the CLIPINFO directory and associated clip information

20   files recorded therein. The A/V stream area has the A/V streams for the various titles recorded therein.

[0036]   Video and audio data are typically organized as individual titles; for example, different movies represented by the video and

audio data are organized as different titles. Furthermore, a title may be organized into individual chapters in much the same way a book is often organized into chapters.

[0037]   Because of the large storage capacity of the newer,

5   high-density recording media such as BD-ROM and BD-RE optical disks, different titles, various versions of a title or portions of a title may be recorded, and therefore, reproduced from the recording media. For example, video data representing different camera angles may be recorded on the recording medium. As another example, versions of title or portions thereof associated

10   with different languages may be recorded on the recording medium. As a still further example, a director's version and a theatrical version of a title may be recorded on the recording medium. Or, an adult version, young adult version and young child version (i.e., different parental control versions) of a title or portions of a title may be recorded on the recording medium. Each version,

15   camera angle, etc. represents a different reproduction path, and the video data in these instances is referred to as multiple reproduction path video data. It will be appreciated that the above examples of multiple reproduction path video data are not limiting, and the present invention is applicable to any type or combination of types of multiple reproduction path video data. As will be

20   described in detail below with respect to embodiments of the present invention, the data structures according to the present invention include path management information and/or navigation information for managing reproduction of multiple reproduction path video data recorded on the

recording medium.

[0038]   A first embodiment of the reproduction path management information for use in the data structure according to Fig. 2 will now be described with respect to Fig. 4. Fig. 4 illustrates an embodiment of

5   the data structure for managing the multiple reproduction path data streams. As shown, the data stream for each reproduction path are logically managed as respective clip files. For example, data streams of a first reproduction path may be managed by a first clip file Clip File #1, data streams of a second reproduction path may be managed by a second clip file Clip File #2, and data

10   streams of a third reproduction path may be managed by a third clip file Clip File #3, respectively.

[0039]   As further shown, each of the clip files Clip File #1 to Clip File #3 is divided into a plurality of interleaving units IU so that the first through third clip files Clip File #1 to Clip File #3, and the data streams of the

15   clip files are sequentially recorded in a physically interleaved fashion in the particular recording region of the recording medium. Namely, an interleaving unit IU from the first path P1 is recorded, then an interleaving unit IU from the second path P2 is recorded, then an interleaving unit IU from the third path P3 is recorded, etc. Each interleaving unit IU includes one or more entry

20   points (EPs), which are referenced in an EP map of a clip information file Clip Info File corresponding to the one of the first through third clip files Clip File #1 to Clip File #3 associated with the interleaving unit IU.

[0040]   When the data stream of the first reproduction path P1 is

to be read and reproduced at the request of the user, the optical disc apparatus (discussed in detail below with respect to Fig. 8) reproduces the interleaving units IU associated with the first reproduction path P1, and skips the interleaving units IU of the second and third reproduction paths P2 and

5   P3. It will be appreciated that this reproduction and jumping operation is performed based on the EP map associated with the clip file of the selected reproduction path.

[0041]   When, as shown in Fig. 4, a path change to, for example, the second reproduction path P2 is requested during a reproduction of the

10 first reproduction path P1, the optical disc apparatus completely reads out and reproduces the data stream of the first path corresponding to the interleaving unit IU being reproduced at the point in time when the path change is requested, searches for the data stream of the second reproduction path corresponding to the next interleaving unit IU, and reads out and

15 reproduces the interleaving unit IU located in the search. As will be appreciated from the forgoing, according to this embodiment of the present invention, a change between reproduction paths takes place at an interleaving unit level. Namely, each interleaving unit starts and ends with a reproduction path change point.

20   **[0042]**   Fig. 5 illustrates the interleaving unit IU data structure according to one embodiment of the present invention. As shown, a predetermined number of entry points, for example, N entry points forms each interleaving unit IU. Each entry point may have a variable time length.

Accordingly, the time length of each interleaving unit IU may be variable.

[0043]   Length information of each interleaving unit, IU_length, may be recorded in the clip information file Clip Info File associated with the clip file to which the interleaving unit IU belongs. Alternatively, this length

5 information may be recorded in a play list file or a play item PlayItem.

[0044]   The length of each interleaving unit should be set so as to prevent any buffer underflow from occurring during a jumping operation from the interleaving unit to another interleaving unit of the same reproduction path while preventing the buffer size from becoming excessively large.

10   [0045]   For example, in the case of an excessively short interleaving unit length, a buffer underflow may occur during a big jumping operation. Furthermore, there is a drawback in that it is necessary to record and manage a relatively large amount of interleaving unit length information. On the other hand, in the case of an excessively long interleaving unit length,

15 a much larger sized buffer for temporarily storing a read data stream is required.

[0046]   For this reason, a system designer should design the length of each interleaving unit IU taking into consideration buffer underflow, buffer size, and efficiencies of recording and managing interleaving unit

20 length information.

[0047]   Fig. 6 illustrates the interleaving unit IU data structure according to one embodiment of the present invention. As shown, the number of entry points forming each interleaving unit IU, regardless of reproduction

path, is variable. For example, Fig. 6 shows N entry points forming interleaving unit IU_P#1-1 from first reproduction path P1 and interleaving unit IU_P#3-2 from third reproduction path P3, K entry points forming interleaving unit IU_P#2-1 from second reproduction path P2, and S entry

5 points forming interleaving unit IU_P#3-1 from third reproduction path P3, where N ≠ K ≠ S. In one exemplary embodiment, each variable-length interleaving unit IU may correspond to an associated chapter of each clip file.

[0048]   As further shown in Fig. 6, the entry point map in the clip information file associated with each clip file includes an interleaving unit end

10 flag IU_End_Flag associated with each entry point. Each interleaving unit end flag IU_End_Flag indicates whether the associated entry point is the last entry point of an interleaving unit. For example, an interleaving unit end flag set to 1, "IU_End_Flag = 1", may be recorded in association with each of the last entry points of interleaving units IUs in the EP maps, whereas an interleaving

15 unit end flag set to 0, "IU_End_Flag = 0", may be recorded in association with the entry points other than the last entry points of interleaving units in the EP maps.

[0049]   When a path change to a particular path is requested during reproduction of, for example, the data streams of the entry points

20 included in the interleaving unit IU_P#1-1 of the first clip file corresponding to the first reproduction path P1, as shown in Fig. 6, respective interleaving unit end flags IU_End_Flag of the entry points included in the interleaving unit IU_P#1-1 are identified. The data streams of the interleaving unit

IU_P#1-1 are reproduced up through the data stream of the entry point identified to include an interleaving end flag IU_End_Flag = 1, that is, the last entry point in the interleaving unit IU_P#1-1. Thus, the interleaving unit IU_P#1-1 is completely reproduced up through the data stream of the last

5 entry point thereof.

[0050] After the complete reproduction of the interleaving unit IU_P#1-1, the clip information file associated with the clip file of the particular path requested to be reproduced, for example, the third reproduction path P3, is searched for the starting entry point of the next interleaving unit thereof,

10 that is, interleaving unit IU_P#3-2. Namely, the first entry point in the third reproduction path P3 following the entry point in the third reproduction path P3 with an IU_End_Flag set to 1 is searched. The clip file corresponding to the third reproduction path P3 is then successively reproduced in a jumped fashion, starting from the starting entry point of the interleaving unit

15 IU_P#3-2. As will be appreciated from the forgoing, a change between reproduction paths takes place at an interleaving unit level. Namely, each interleaving unit starts and ends with a reproduction path change point, and in this embodiment of the interleave unit, a flag indicates the path change points.

20 [0051] Thus, the data streams of the first reproduction path P1 and the data streams of the third reproduction path P3 are successively reproduced in a seamless fashion in the unit of interleaving units IU.

[0052] Alternatively, the first entry point of each interleaving

unit IU is recorded with identification information representing the start of the interleaving unit IU. For example, an interleaving unit start flag set to 1, "IU_Start_Flag = 1", may be recorded in association with each of the first entry points of interleaving units IUs in the EP maps, whereas an interleaving unit

5   start flag set to 0, "IU_Start_Flag = 0", may be recorded in association with the entry points other than the first entry points of interleaving units in the EP maps.

[0053]   Fig. 7 illustrates the time alignment that exists between the EP maps for the different clip files. As discussed, an EP map maps the

10   presentation time stamp information to a source packet. More particularly, the presentation time stamp is mapped to the address or identifier of the source packet. The address or identifier is the source packet number (SPN). Fig. 7 further shows the source packets by source packet number along the presentation time stamp axis for each clip file 1, 2, and 3. As shown, source

15   packets in each of the EP maps 1, 2, and 3 have the same presentation time stamps. For example, source packet x1 from the first clip file 1, source packet y1 from the second clip file 2 and source packet z1 from the third clip file 3 have the same presentation time stamp T1. As such, the EP maps 1, 2 and 3 are time-aligned. Because of this time-alignment, seamless reproduction of

20   video data is possible even when the reproduction path is changed during reproduction. Fig. 7 illustrates changes in reproduction path by two concentric circles. As shown, if a user decides to change the reproduction path from clip file 2 to clip file 1 during reproduction of the second clip file 2

and a change is permitted after reproduction of source packet y2, then after completing reproduction of source packet y2, source packet x3 is the next source packet reproduced. Similarly if a user decides to change reproduction path (e.g., change camera angle to view) from clip file 1 to clip file 3 during

5 reproduction of clip file 1 and a change is permitted after reproduction of the source packet x4, then after completing reproduction of source packet x4, source packet z5 is reproduced. It will be understood that the source packet numbers given in the example above are merely exemplary, and that a source packet in one clip file will not, generally, have the same source packet number

10 as a time aligned source packet in another clip file.

[0054]   Fig. 8 illustrates a schematic diagram of an embodiment of an optical disk recording and reproducing apparatus according to the present invention. As shown, an AV encoder 9 receives and encodes audio and video data. The AV encoder 9 outputs the encoded audio and video data along

15 with coding information and stream attribute information. A multiplexer 8 multiplexes the encoded audio and video data based on the coding information and stream attribute information to create, for example, an MPEG-2 transport stream. A source packetizer 7 packetizes the transport packets from the multiplexer 8 into source packets in accordance with the

20 audio/video format of the optical disk. As shown in Fig. 8, the operations of the AV encoder 9, the multiplexer 8 and the source packetizer 7 are controlled by a controller 10. The controller 10 receives user input on the recording operation, and provides control information to AV encoder 9, multiplexer 8

and the source packetizer 7. For example, the controller 10 instructs the AV encoder 9 on the type of encoding to perform, instructs the multiplexer 8 on the transport stream to create, and instructs the source packetizer 7 on the source packet format. The controller 10 further controls a drive 3 to record the

5   output from the source packetizer 7 on the optical disk.

[0055]   The controller 10 also creates the navigation and management information for managing reproduction of the audio/video data being recorded on the optical disk. For example, based on information received via the user interface (e.g., instruction set saved on disk, provided

10   over an intranet or internet by a computer system, etc.) the controller 10 controls the drive 3 to record the data structure of Figs. 2, 4, and 5 and/or 6 on the optical disk.

[0056]   During reproduction, the controller 10 controls the drive 3 to reproduce this data structure. Based on the information contained

15   therein, as well as user input received over the user interface (e.g., control buttons on the recording and reproducing apparatus or a remote associated with the apparatus), the controller 10 controls the drive 3 to reproduce the audio/video source packets from the optical disk. For example, the user input may specify a path to reproduce. This user input may be specified, for

20   example, via a menu based graphical user interface preprogrammed into the controller 10. Using the user input and the path management information reproduced from the optical disk, the controller 10 controls the reproduction of the specified path or changing the reproduction of the specified path as

described in detail above with respect to the embodiments of the present invention.

[0057]   The reproduced source packets are received by a source depacketizer 4 and converted into a data stream (e.g., an MPEG-2 transport

5   packet stream). A demultiplexer 5 demultiplexes the data stream into encoded video and audio data. An AV decoder 6 decodes the encoded video and audio data to produce the original audio and video data that was feed to the AV encoder 9. During reproduction, the controller 10 controls the operation of the source depacketizer 4, demultiplexer 5 and AV decoder 6. The controller 10

10   receives user input on the reproducing operation, and provides control information to AV decoder 6, demultiplexer 5 and the source packetizer 4. For example, the controller 10 instructs the AV decoder 9 on the type of decoding to perform, instructs the demultiplexer 5 on the transport stream to demultiplex, and instructs the source depacketizer 4 on the source packet

15   format.

[0058]   While Fig. 8 has been described as a recording and reproducing apparatus, it will be understood that only a recording or only a reproducing apparatus may be provided using those portions of Fig. 8 providing the recording or reproducing function.

20   [0059]   As apparent from the above description, the present invention provides a multi-path data stream managing method and apparatus for high-density optical discs that can rapidly and accurately select the data streams of the path designated by the user for reproduction and reproduce

the selected data streams, while being capable of efficiently suppressing occurrence of a buffer underflow and an increase in buffer size.

[0060]   As will be appreciated from the forgoing disclosure, the present invention provides a recording medium having a file or data structure

5 that permits managing and/or controlling navigation of the reproduction of video data on a multiple reproduction path basis. Accordingly, the present invention provides a greater level of flexibility in the reproduction of video data than previously available.

[0061]   While the invention has been disclosed with respect to a

10 limited number of embodiments, those skilled in the art, having the benefit of this disclosure, will appreciate numerous modifications and variations there from. For example, while described with respect to a Blu-ray ROM optical disk in several instances, the present invention is not limited to this standard of optical disk or to optical disks. It is intended that all such modifications and

15 variations fall within the spirit and scope of the invention.